An Explanation of the Adjustment of Ships' Compasses. By Commander L. W. P. Chetwynd, R.N. Pp. 24. (London: J. D. Potter, 1909.) Price 2s.

THIS useful little book, the sections of which are accompanied by diagrams, is an endeavour on the part of the author to convey to the reader in as concise a manner as possible the various causes of deviation, and the methods of overcoming them, without the use of mathematical formulæ.

In most treatises dealing with this subject it is, unfortunately, the case that they are too theoretical and contain too many symbols to suit the average seaman; therefore great praise is due to Commander Chetwynd for the able manner in which he has brought out a practical book for practical people. H. C. L.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

An Inquiry concerning Scientific and Medical Journals.

CAN any of your readers kindly inform me where copies of the following journals can be found in England, if possible in London?

(*a*) *Lo Spallanzani.* This is a journal of the medical and natural sciences published at Modena in the 'seventies and 'eighties.

(*b*) *Mittheilungen d. Wiener embryol. Institut.* Published in the 'eighties, and perhaps still.

(*c*) *Gazette médicale d'Algérie.* Published at Algiers in the 'fifties.

(*d*) *Ann. Soc. méd. d'Émulation de la Flandre occid.* Roulers, 1849. There are other references to a *Soc. méd. d'Émulation*, without place or name. I should be very glad to have these *Soc. méd. d'Émulation* cleared up, as there must, I think, have been several such societies.

(*e*) *Baltimore Sun*, 1876. The stock of this journal was burnt. Is there a file of it anywhere in England?

(*f*) *Archiv de méd. nav.* Published at Paris in the 'seventies.

(*g*) *Archiv f. Psych. u. Nervenkrankheiten*, for the 'eighties.

(*h*) *Sociedad medica Argentina*, 1901.

(*i*) *International Med. Magazine.* Philadelphia, 1892.

(*j*) *Zeitschrift f. Tiermedicin*, 1897. (Sought at Royal Veterinary College.)

(*k*) *Soc. med. Württemberg*, 1905.

These have been sought for at the likely places, but it is possible that they exist and have been overlooked. It is a pity that some of the larger libraries in London duplicate certain of the *rarer* scientific and medical journals, whereas by a division of material they might provide a more comprehensive collection. Further, there ought to be at least one library in London with a complete set of university dissertations and degree theses. No library at present appears to make a speciality of such material. I have always found German university librarians most willing to lend copies, but the delay is vexatious, and a cursory examination of five minutes' duration would often have settled the point required. KARL PEARSON.

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Radio-activity in Relation to Morozoff's Theory of the Constitution of Atoms.

THE fact that the α particles of radium, as shown lately by Prof. Rutherford and Geiger,[1] carry two elementary charges of positive electricity, $2 \times 4 \cdot 65 \times 10^{-10}$ E.S.U. per atom of helium, appears quite unexpected, and requires consideration. Since the atom of helium carries more than a single charge, which would present the simplest and most natural contingency, there arises the question, Why does it carry just two charges and not one or more? an answer to which has been proposed by N. L. Müller in the "Jahrbuch der Radioaktivität" (v., 702, 1908), but it seems to me that the following explanation, based upon the Morozoff theory of the constitution of atoms,[1] will not be devoid of interest.

According to Morozoff, all the chemical elements are formed by manifold combinations of three primordial elements, viz. archonium (nebulium) (Z), with a combining weight 4; protohelium (x), with a combining weight 2; and protohydrogen (h), with a combining weight 1. Of these, protohelium, as shown by the value of its combining weight, presents half an atom of ordinary helium, the re-combination of two of which yields again a helium atom.

Archonium (Z), with its eight affinities, plays the part of carbon in organic compounds, the archonium elements, more or less saturated with protohelium (x) and protohydrogen (h), building the main atomic chain. The chains of various chemical elements are built of one to eleven such links, which, combined after certain rules, allow us to reconstitute the whole periodic system of elements.

As in the notation of organic chemistry, the atom of radium is represented in Morozoff's system by the following symbol:—

$$x - Z(x_2h) - [Z(xh)_6]_9 - (x_2h)Z - x.$$

Radio-activity is due to closing of the chain, accompanied by splitting off of two helium half-atoms (x),

$$\underline{Z(x_2h) - [Z(xh)_6]_9 - (x_2h)Z} + 2x.$$

which yield the material carriers of electricity of the α particles.

Since both extreme helium half-atoms (x) are expelled under similar conditions, and since they carry electricity, each of them cannot carry less than one elementary charge of $4 \cdot 65 \times 10^{-10}$ E.S.U., hence a whole atom of helium must carry at least two elementary electric charges, or $9 \cdot 3 \times 10^{-10}$ E.S.U.

As not only radium, but also thorium and uranium, are represented by similar symbols, and their radio-activity is always accompanied by the expulsion of two helium half-atoms, it is evident that in all known radio-active changes an atom of expelled helium must carry at least two elementary charges. If we call, further, as has been done by Maxwell, an elementary charge an atom of electricity, we can consider the combination of two of them as a molecule of electricity, and state the following general law:—in all radio-active changes the smallest quantity of electricity associated with an atom of matter is not an atom ($4 \cdot 65 \times 10^{-10}$), but a molecule of electricity ($9 \cdot 3 \times 10^{-10}$). B. DE SZYSZKOWSKI.

Kieff, Zolotoworotska 6, Russia, April 16.

[1] Proc. Roy. Soc., lxxxi., 162 (1908), and *Physikalische Zeitschrift*, x., 42 (1909). Also NATURE, November 5, 1908.

[1] *Physical Review* (Russian), ix., 73, 121 (1908).

The Gravitative Strain upon the Moon.

IN his discourse on "The Æther of Space" at the Royal Institution, February 21, 1908 (abstracted in NATURE, vol. lxxix., p. 323), Sir Oliver J. Lodge states that "the force with which the moon is held in its orbit would be great enough to tear asunder a steel rod four hundred miles thick, with a tenacity of thirty tons per square inch," and he further states that Maxwell calculated the gravitational stress near the earth to be 3000 times that which the strongest steel could stand, and near the sun it should be 2500 times as strong as that.

For convenience we may call the diameters of the earth and of the moon 8000 and 2160 miles respectively, and the moon's distance from the earth 240,000 miles. At the surface of the earth the moon would fall 16·1 feet, or 1/328 mile, in one second. The velocity necessary to counteract this fall is, therefore, equal to $\sqrt{8000 \times 1/328}$, or about five miles per second, at which velocity the centrifugal force of the moon, revolving at a distance of

4000 miles from the earth's centre, would just balance the earth's attraction of gravity. So that, if this attraction were absent, and the two bodies were connected by a rod, or material bond, instead, there would be continual strain on such bond equal to the moon's weight at the earth's surface.

Now, the volume of the earth is $8000^3 \times 0.5236$ cubic miles, or about 4×10^{22} cubic feet, which, multiplied by $5\frac{1}{2}$ and $62\frac{1}{2}$, gives 1375×10^{22} lb., or 6875×10^{18} tons (the value given by Cavendish's experiment is 6.14×10^{21} tons, the difference being due to the larger value of the earth's diameter here used), the moon's weight at the earth's surface being, therefore, $6875 \div 80$, or 86×10^{18} tons, which would be the strain on the material bond connecting the two bodies as above in the absence of gravity. As this strain varies directly as the mass of the revolving body and the square of its velocity, and inversely as its distance or radius of revolution, then at the moon's actual distance of 240,000 miles, and velocity of 0.64 mile per second, the strain would be diminished by the factors $4000/240000 \times (0.64/5)^2$ or $1/3600$; that is, to $86 \times 10^{18}/3600$, or 24×10^{15} tons. Thus if some Titan should, like a stone in a sling, whirl the moon at its present velocity and distance around his finger, the strain upon the string would be 24×10^{15} tons, which, if the string be of the same thickness as the moon itself, gives about 1.6 tons per square inch, necessitating a steel rod about 400 miles in thickness of thirty tons per square inch tenacity, just as Sir O. Lodge states.

But have we not neglected a very important factor in this computation? As the moon moved away from the earth's surface to its present distance, we allowed for its change of velocity and distance as affecting its centrifugal force; but should we not also allow for the diminution of gravity at the increased distance? The tension of the stone in the sling upon its restraining cord would be less at the greater distance owing to the decreased velocity and to the effect of the increased distance upon the centrifugal force; but as the stone moved outwards it would also come into a weaker field of gravitative force, which would further reduce the strain inversely as the square of the distance (just as if its mass had been diminished), or by the factor $1/3600$, thus reducing the total strain of 24×10^{15} tons obtained above for the moon at its present distance and velocity to $24 \times 10^{15}/3600$, or $6\frac{2}{3} \times 10^{12}$ tons for its actual present value, requiring a steel rod only about $6\frac{1}{2}$ miles thick and of the same tenacity as before.

EVAN MCLENNAN.

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The Inheritance of Acquired Character.

I HAVE received the following from my brother, Dr. A. W. Smyth, late superintendent of the United States Mint at New Orleans. He has experimented with bees and written papers on them, which have been published in several bee-journals throughout the world.

He says, The commonly accepted view, stated by Dr. Francis Darwin in his presidential address, that the queen bee is entirely isolated, so as to bar the ordinary course of inheritance, is not so. According to Dr. Smyth, some of the workers occasionally lay eggs, and these eggs always produce drones, which, coming to fertilise the queen, opens the path for the ordinary course of inheritance. Upon this principle he bases an explanation of the following facts. In Morocco the honey-bee has foes in the form of certain beetles. To guard their stores the bees have come to build pillars of wax at the entrance to the hive, which prevents the entrance of the beetle. This becomes a habit, and a habit that could only have arisen as an acquired character, and it could only have reached workers through the queen being fertilised by drone-offspring of the workers. When a Morocco queen is brought to this country, where these beetles do not exist, the progeny of the queen continue to build pillars of wax; in the course of time this acquired habit becomes attenuated. WM. WOODS SMYTH.

Maidstone, April 17.

THE IMPERIAL SIDE OF THE FUEL QUESTION.

THE returns issued by the Board of Trade on February 24, dealing with the output of coal in the United Kingdom during 1907, should go far to convince the most callous that our fuel supply is at the present moment every whit as important an Imperial question as keeping up our first line of defence to the two-Power standard or forming an efficient citizen army, and that unless due prominence and consideration is given to it, it is impossible for our Navy and Army, no matter how good, to save the nation for more than a limited period.

Our kingdom has but two capital assets, labour and coal, and without the latter labour would count for but little in face of competition with nations possessing the means of economic power production; so that the real measure of England's power and prosperity is to be found in her store of unwon coal and her ability to husband the resources with which nature has endowed her in order that she shall retain the same relative position towards other nations that she does at present.

Not only has America the largest store of coal in the world, but until lately the amount that has been mined has been comparatively small, and out of all proportion to the magnitude of her coalfields. The close of the last century, however, saw her an easy first as regards the output of coal, and she now raises at least a third more than the United Kingdom.

It is, however, with the position of nations nearer home in respect to this question that we are at the present time more deeply interested, and in order to gain an idea of the relative life of their fuel supplies as compared with our own, it is necessary to contrast their rate of output with the available quantities of coal still unused.

The Royal Commission on Coal Supplies, which sat from 1901 to 1905, collected all the evidence possible as to the amount of coal still existing in this country, which at the rate of output then obtaining would last something like six hundred years, but they also gave warning that "vast as are the available resources, it must be borne in mind that a large percentage of them are of inferior quality, or are contained in deeper and thinner seams which cannot be worked at the present cost"; whilst the rate of consumption is increasing so rapidly that the output of 236,000,000 tons of coal in 1905 had risen in 1907 to 267,831,000 tons.

Such factors as these mean an inevitable and increasing rise in the price of coal, and it must be clear that it will be the time when coal has risen to such a price as seriously to hamper our power of competing with other European countries that will govern the period of our commercial supremacy, and not the date of the complete exhaustion of our coalfields.

Taking such figures as are available for the coal resources of the more important coal-producing European countries and the returns of the coal raised in 1905 and 1907, we may tabulate them as follows:—

	Total existing coal, in millions of tons	Coal raised 1905	Coal raised 1907
United Kingdom ...	140,000 ...	236,130,000 ...	267,831,000
Germany	150,000 ...	119,349,000 ...	140,835,000
France	17,000 ...	34,780,000 ...	35,586,000
Belgium	16,000 ...	21,500,000 ...	23,324,000

So that for all practical purposes the quantity of coal still existing in Germany may be taken as being the same as ours, the extra 10,000 million tons which that nation possesses being made up for by the superior quality of our steam and gas coals.